

and when the two thermometers read alike, the atmosphere is exceedingly damp."

This statement is not likely to give any very definite idea of the conclusions which may be drawn from the readings of the thermometers, and the difference may be less at one time than another, and yet the air be "drier."

In cyclonic systems, the author says, "the air circulates more rapidly [than in anti-cyclonic], causing strong winds, and appears to flow in towards the centre, so that it must naturally be supplied from below and ascend in the centre." Here the rapid circulation of the air is said to be the cause of the wind. It is also said elsewhere that it is calm in the centre. Is it meant as a result of observation that the air flows towards the centre? and is it a result of observation that the air (naturally or not) rises in the centre?

We have already alluded to the little use of the tension of vapour in "storm warnings." With reference to one case, we find: "The absence of rain is very noticeable during the early period of the gale; the reason for this absence can be seen from the fact of the great distance [on the curves given] between the wet and dry thermometers." The difference is about 3° with the dry thermometer near 50° , and the wind blew "pretty steadily from S.S.W. for twenty hours" (p. 68). If the fact that it did not rain was an unusual one under the circumstances, and if that depended on the difference of the thermometers, the question seems to us only changed to what was the reason of the difference?

We do not always read the curves as the author has done, nor always agree with his reasoning from them; and in some cases, as p. 72, where one cyclone has passed eastwards, north of a station, leaving a N.W. wind, and is followed by another also passing north, the author has not made it very clear why the wind should back to S.W., to S., and S.E., through the action of the S.E. wind of the second cyclone meeting the N.W. of the first.

These queries and suggestions do not affect the general character of the book, which we can recommend as a useful and instructive companion in the study of weather charts, and for the comprehension of storm-warnings as they are issued from the Meteorological Office. It is much to be desired for the many who will not read this work, yet cast a curious eye on the isobars in the newspapers, that some condensed statement of the general rules should occasionally accompany them.

JOHN ALLAN BROWN

GEIKIE'S GEOLOGICAL MAP OF SCOTLAND

Geological Map of Scotland. By Archibald Geikie, LL.D., F.R.S., Director of the Geological Survey of Scotland; Murchison Professor of Geology and Mineralogy in the University of Edinburgh. (Edinburgh and London: W. and A. K. Johnston, 1876.)

SINCE the publication of the last edition of the sketch-map by Sir R. I. Murchison and Prof. Geikie, no general geological map of Scotland has, so far as we are aware, been issued, while those older than the sketch-map rather served as guides to localities where minerals and rocks were to be found, than afforded any clue to the sub-

divisions of geological time represented by our ancient formations. During the last twelve years, however, materials have been accumulating which have daily rendered the sketch-map more and more inadequate to the purposes for which it was originally designed, and it had obviously become necessary either to issue a new edition, or to "reform it altogether." Considering all things, and especially that he could no longer avail himself of the co-operation of his late colleague, Prof. Geikie has, wisely we think, decided on the latter course. The comparatively large scale adopted (ten miles to the inch), gives room for a number of details which had to be omitted from previous maps.

The publication, for the greater part of the south of Scotland, of the Geological Survey Maps on the scale of one-inch and six-inches, reduces to some extent the operations of the compiler to the selection of as much of the details as his map gives him room to insert. At the same time there are many points regarding the relations of distant deposits which can be better seen on reviewing the work as a whole than during the progress of detailed mapping, and on some of these, as we shall presently point out, Prof. Geikie takes up an independent position.

The northern half of Scotland is in a very different state as regards our knowledge of its geology. Here and there, it is true, competent observers have selected choice bits, and have worked them out with a thoroughness that leaves little to be desired. But a great part of the Highlands is still unknown to geologists, or only known in so far as concerns its comparatively simple glacial phenomena. For this region we have to consult "geognostic travels" of the beginning of the century, and put the best construction on them that we can. It is not, therefore, to be wondered at that this portion of the map is somewhat vague. The metamorphic rocks of the Highlands offer difficult problems to the chemist and physicist, as well as to the geologist; and whoever attempts to unravel their structure as a whole, must probably be content to work for some years in the dark, and with the consciousness that he may not see the issue of his own labours.

Till recently the Southern Uplands were pretty much in the same state as the Highlands, but the detailed work of the geological survey, and a few private observers, has filled up this great blank and rendered possible a comparison of the structure of the Silurian rocks there with those of England and Ireland. On the map now before us, are laid down, for the first time, all the more important graptolite bands which for a hundred miles, at least, appear at intervals among the upturned Lower Silurian strata between the Rhinns of Galloway and the Tweed, while a marginal section explains how the Llandeiloid beds, after folding over and over, are unconformably succeeded near the northern edge of the uplands by Caradoc basins, and on the south by rocks supposed to be Upper Silurian. It thus appears that on the southern side of Murchison's "axial beds" only a small part of the northern series is repeated, the place of the Moffat shales not being reached at the point where the Upper Silurian rocks begin.

North of the Uplands a notable feature of the new map is the rearrangement of the Old Red and Carboniferous boundary-line. The identity of the bright-red, sharp, siliceous sandstones below the cement-stone series of the

Lower Carboniferous group with the sandstones answering to the same description that rest unconformably on the Lower Old Red of Forfarshire is regarded as established notwithstanding the occurrence in their associated limestones (in Nithsdale and elsewhere) of carboniferous limestone fossils. This bold course may be taken as a protest, on Prof. Geikie's part, that such questions are not to be settled on palæontological grounds alone.

Along the southern edge of the Grampians the present map shows that the fault which for a long distance separates the Silurian slates from the Old Red Sandstones and conglomerates, runs all the way from Strathearn to Glen Esk (a distance of about fifty miles), within the old red area. Here then we have a noble exposure of the base of that formation abutting against its Silurian shores; and we learn from its interbedded igneous rocks and trapean conglomerates, that even thus early, volcanic activity had set in on the margin of the Highlands. As far north as the Orkney Isles, the sub-divisions of the old red have been re-arranged, Prof. Geikie having himself observed the unconformability of the red sandstones (Upper Old Red) on the Caithness Flags on the west coast of Hoy.

In the Silurian Highlands many of the chief folds and variations of the metamorphic rocks are clearly indicated, and old mineralogical observations are corrected, largely through Prof. Geikie's own frequent traverses. The Laurentian and Cambrian rocks of the north-west coasts and islands seem to have suffered no changes since the publication of the sketch-map, except slight rectifications of boundaries required by the larger scale.

Much light has been thrown within the last few years on the mesozoic and tertiary rocks of the Moray Firth, Skye, Mull, and Arran, and this new information has been skilfully embodied in the map. Besides his own work in this department Prof. Geikie justly acknowledges his obligations to Ramsay, Judd, Bryce, and Zirkel.

It has been found possible to indicate at least two phases of the Glacial epoch, that of the main extension of the ice-sheet, and that of the later local glaciers. Of the direction of the ice-flow during the former phase an idea may be gathered from the arrows denoting observed glacial striae, while the moraines of the later period are shown by a neat system of stippling. Both in the Highlands and the Southern Uplands the number of valleys containing glaciers seems to have been very great. Scotland must have been a magnificent country for tourists in these pre-historic times.

In conclusion, we need only say that geological students have now in their hands a portable map that will supply them with much valuable information, and with suggestions equally valuable with regard to problems awaiting solution. Prof. Geikie is to be congratulated on the successful completion of a task for which he was peculiarly qualified, both by his position as Director of the Survey and by his thorough acquaintance with the minutest details of Scottish geology. R. L. J.

OUR BOOK SHELF

Botanical Reminiscences in British Guiana. By Richard Schomburgk. (Adelaide: 1876.)

THE able and indefatigable superintendent of the Botanic Garden at Adelaide was appointed, many years since, by

the Prussian Government, naturalist to the Boundary Expedition to British Guiana entrusted by the British Government to his late brother, Sir Robert Schomburgk; and in this small, but extremely interesting volume, he gives an account of that "El Dorado," as he appropriately terms it, of tropical botany. Dr. Schomburgk's description of the floral treasures of the district, and especially of the Roraima mountains, where forms of the most wonderful beauty unfold themselves at every step, and undergo the most rapid transformations with every change of altitude, are enough to make the mouths of stay-at-home botanists water. The expedition was not, however, without its difficulties and dangers. On the Roraima mountain, which rises to the height of about 8,000 feet a few degrees north of the equator, the humidity of the air was so great that the artist who accompanied the expedition found sketching on the saturated paper impossible, while the powder in a loaded gun became changed, in a few hours, into a greasy mass. The ascent of the upper part of this mountain chain was a feat worthy of the most enterprising members of the Alpine Club. A perpendicular wall of sandstone rock, 500 feet in height, had to be scaled by the entire party by means of the net-work of climbing plants which covered it; the giving way of a single root would have involved one or more of the party in certain death. The account of this expedition dissipates the idea that food is everywhere abundant within the tropics, even in thickly-wooded and well-watered countries. For days together the party saw no mammals or birds, and were reduced to the point of starvation from the absence of all esculent vegetables. One observation of Dr. Schomburgk's is important, as being at variance with our modern theories regarding the purpose of the bright coloration of flowers. Near the summit of the mountain range, where the earth was carpeted with flowers of gigantic size, of the greatest brilliancy of colour and delicacy of scent, "it appeared almost as if this boundless abundance of flowers compensated for the total absence of animal life; all was wrapt in deep solemnity; not even a gorgeous humming-bird or a graceful honey-sucker was seen fluttering amongst the flowers." Has this singular observation been confirmed by other American travellers? Dr. Schomburgk's observations were not entirely confined to the flora of the country. While stopping at a Warrau settlement on the Barima river, he records the curious fact of a young woman nursing at one breast a child and at the other a young monkey; and states furthermore, that he has seen, "with the exception of the carnivorous, all kinds of animals suckled and reared by Indian women." While ascending the Roraima mountains his attention was arrested by rows of Indian hieroglyphic writing on the sandstone rock, roughly representing, for the most part, the human form, kaimans, and snakes. There is one defect in this interesting volume, which should have been rectified before going to press. Either from want of exact knowledge of the language on the part of the author, or from the deficiencies of a colonial printing-office, many of the sentences are so inaccurately worded as to be barely intelligible. A. W. B.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

On the word "Force"

In the *Times'* report (Sept. 9, 1876) of Prof. Tait's lecture at Glasgow on Force, it is stated that "the lecturer showed how the incorrect physical ideas of Leibnitz, and some of his followers, had introduced the terms *vis viva*, *vis mortua*, and *vis acceleratrix*," and that these terms were found also in English works. We may add that, until quite lately, Cambridge treatises